

A COMPREHENSIVE GEOTECHNICAL INVESTIGATION AND INSTALLATION OF A BOREHOLE ACCELEROMETER ARRAY IN THE NEW MADRID SEISMIC ZONE

Award Number: 02HQGR0101

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Program Element: I

Key Words: Strong ground motion, Amplification

INVESTIGATIONS UNDERTAKEN

The objective of this investigation is to deploy ground-motion instrumentation and characterize the dynamic site properties so that researchers can evaluate the soil transfer function of post-Paleocene sediments at a site near the center of the New Madrid seismic zone (NMSZ) (Fig. 1). Data from this observatory will constrain existing and future site response models in the region.

The site of the vertical accelerometer array is near the most active part of the NMSZ; therefore, it should provide the maximum amount of data in the shortest period of time. The location of the site is also a few kilometers northeast of the existing UK strong-motion station VSAB that is, on the average, triggered 1 to 2 times a month by an earthquake (Fig. 2).

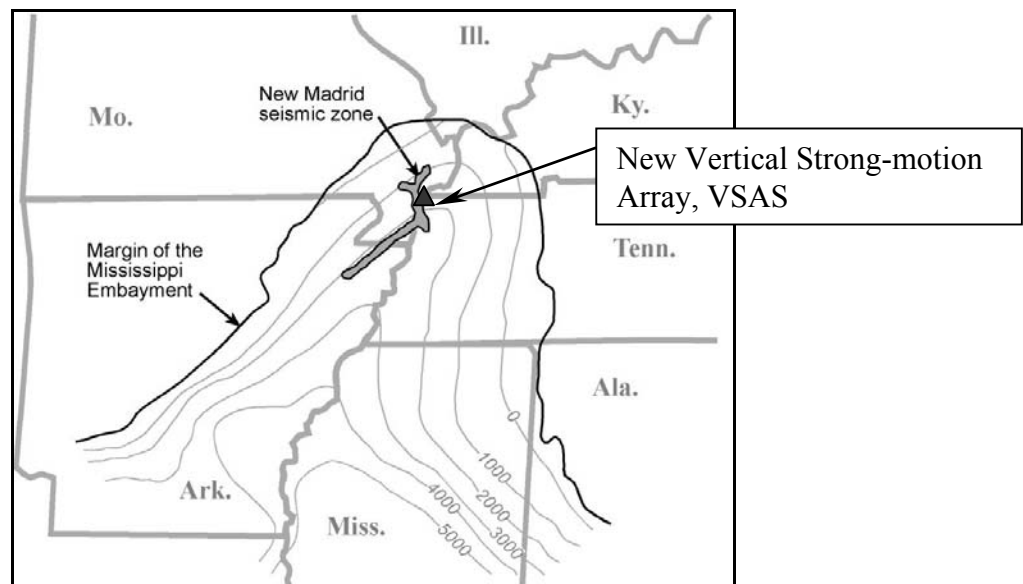


Figure 1. Location of the vertical strong-motion array, VSAS, in the central segment of the New Madrid seismic zone. The contours show sediment thickness in feet below mean sea level.

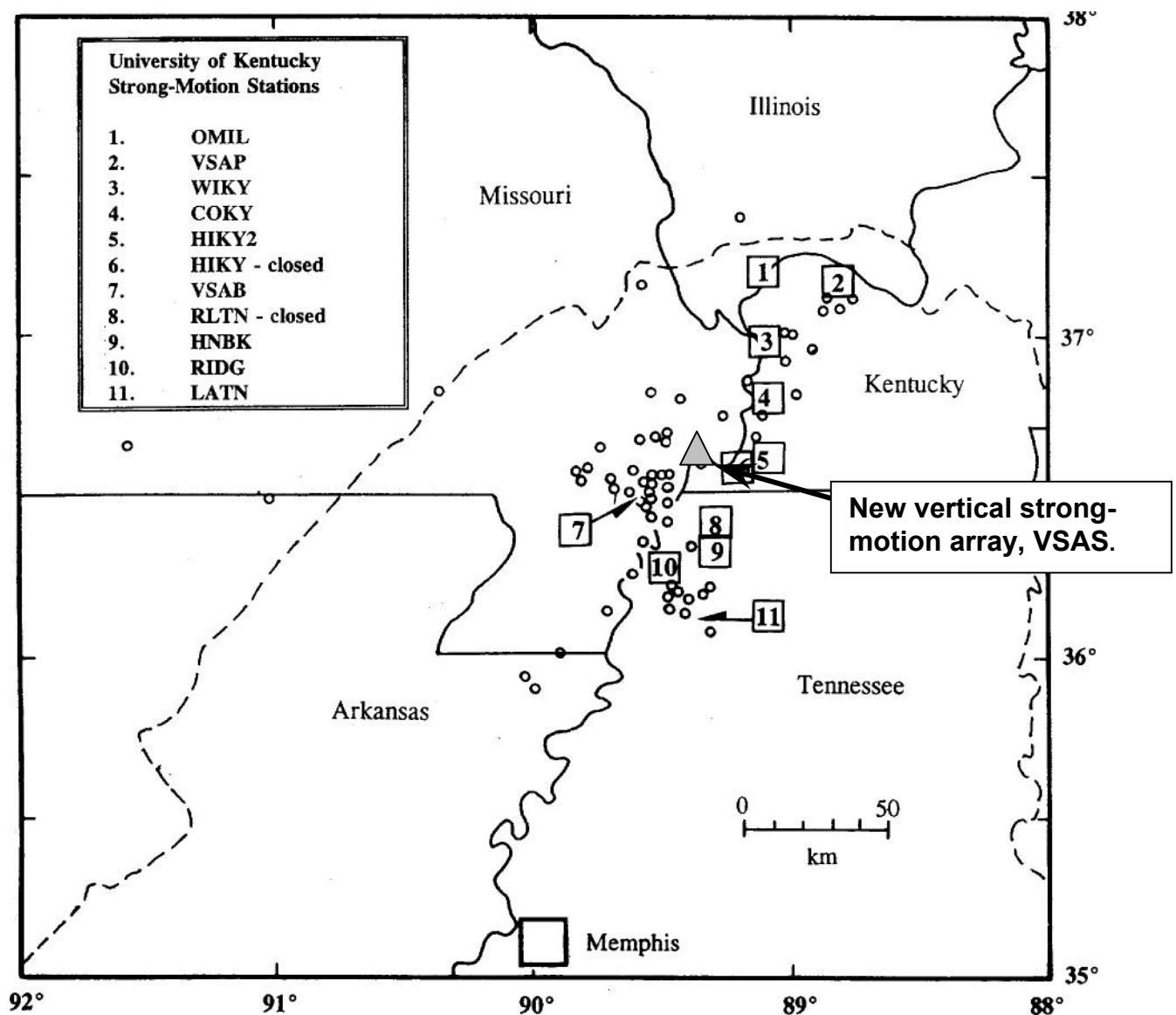


Figure 2. Reference map of the Upper Mississippi Embayment showing the University of Kentucky's strong-motion station locations and recorded events. The shaded triangle depicts the site of the new borehole accelerometer array.

The final vertical accelerometer array (Fig. 3) will consist of three 3-component accelerometers, recorded on a 24-bit, 9-component accelerograph equipped with GPS timing. The "deep" borehole accelerometer will be placed at a defined "stiff" horizon (260 m) below ground surface. The second borehole accelerometer will be placed at the bottom of a 30 m geotechnical hole. This corresponds to the critical depth used for the soil Site Classification as defined in the NEHRP Recommended Provisions. The remaining accelerometer will be a "free-field" installation placed at the top of the geotechnical hole. Surface refraction/reflection, downhole shear wave, and geotechnical index tests will provide final site characterization.

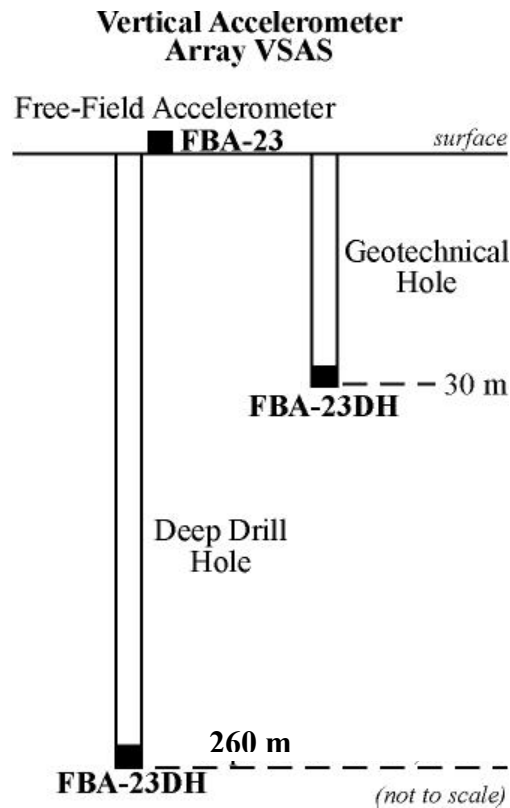


Figure 2. Geometry of the vertical accelerometer array

RESULTS

A Fulton County, Kentucky landowner (Mr. Austin Voorhees) has granted the University of Kentucky a 5-year right-of-entry (with an option to extend) to a small parcel of land for the purpose of installing and operating a vertical strong-motion seismic array in the central NMSZ. Specifically, the array is sited in the community of Sassafras Ridge, Kentucky, at coordinates N 36°33.139', W 89°19.784'. Preliminary surface seismic refraction and reflection surveys at the site identified a shear-wave velocity boundary at approximately 250 meters. This elevation correlates well with the anticipated Eocene–Paleocene stratigraphic boundary. A mud-rotary drilling contractor was subsequently obtained, and a 102-mm cased borehole has been installed to depth of 260 meters. A contract is currently being negotiated to install the 30-meter geotechnical hole. The downhole cable has been ordered, and the Kentucky Geological Survey has purchased and received a 9-channel Kinemetrics K-2 accelerograph, as well as, two FBA-23 accelerometers for the array.

NONTECHNICAL SUMMARY

The thick Mississippi embayment soil/sediment deposits are expected to produce significant site effects in the event of a significant earthquake. Estimating ground motions of earthquake engineering interest in these thick deposits is problematic, however. To address these issues, we

are installing a vertical seismic array consisting of three accelerometers in the most active part of the New Madrid seismic zone. It is anticipated that we can evaluate the effect of deep soil conditions on earthquake ground motions in the NMSZ, characterize the dynamic soil properties (including nonlinear), and validate geotechnical techniques currently being used to characterize deep soil sites. It is also anticipated that we can assess the NEHRP Recommended Provisions as they pertain to the upper Mississippi Embayment sediment. All are important results. The validation of geotechnical techniques currently being used to characterize deep soil sites are applicable to sites throughout the Mississippi embayment, as well as, deep soil sites elsewhere (i.e., southern California).

PUBLICATIONS

None.

DATA AVAILABILITY

Data acquired from this array will be formatted and sent to the COSMOS database, as well as, archived at the Kentucky Geological Survey as raw and processed files. Requests for information should be directed to the PI.